



Illinois Department of Transportation

To: Joseph E. Crowe Attn: District Four
From: John D. Baranzelli
Subject: Pavement Design
Date: May 14, 2012

FAP Route 318 (IL Route 29)
Section (6VB)BR;8R-1;(6,5)R
Peoria County
From Truitt Avenue to south of Senachwine Creek in Chillicothe

We have reviewed the pavement selection for the above captioned section, which was submitted by email dated May 7, 2011. The project will replace the existing railroad structures and construct new pavement throughout the project limits. The approved pavement design is as follows:

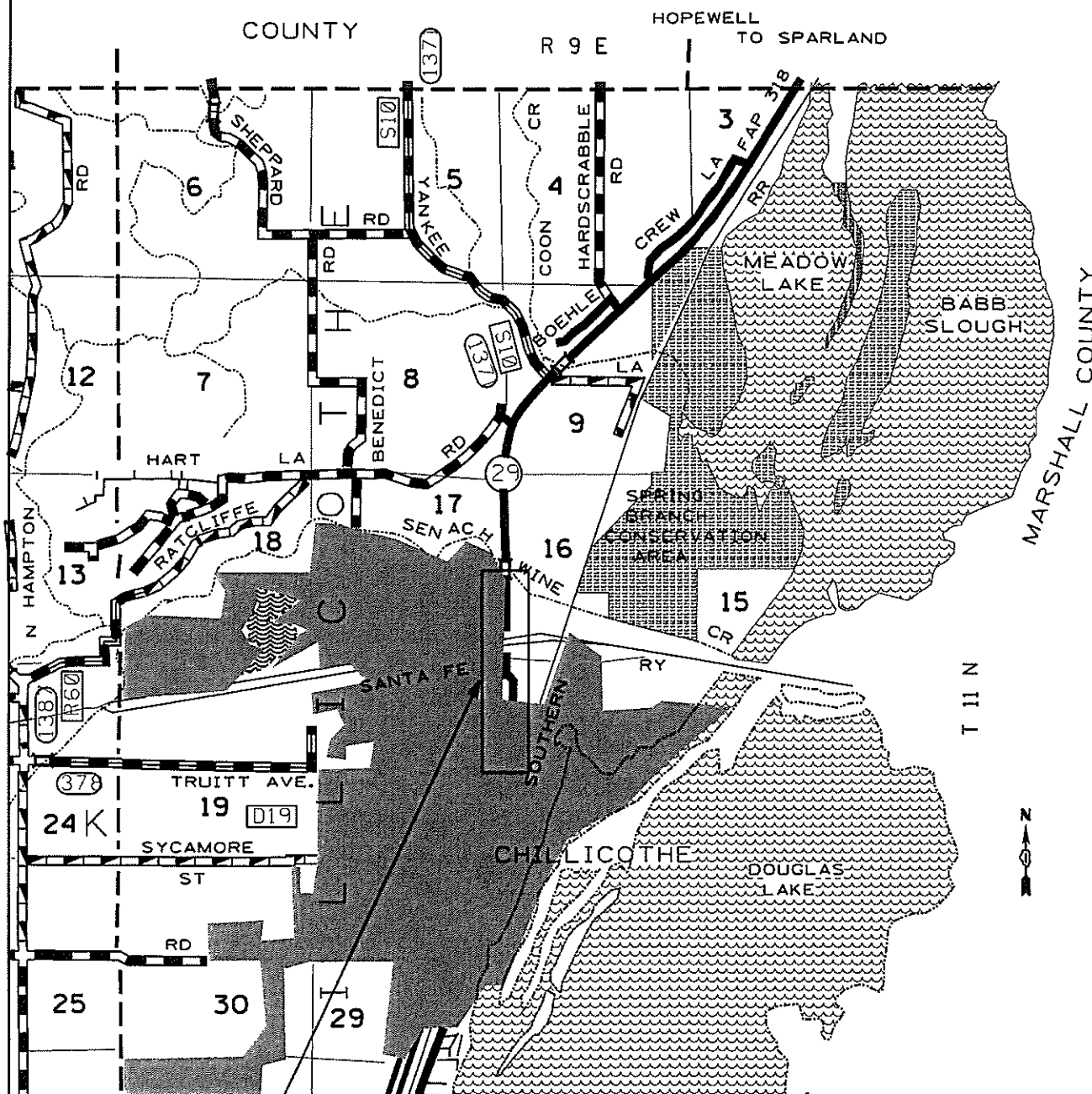
IL Route 29 from Truitt Avenue to south of Senachwine Creek
(Pavement Construction)

9 inches of PCC Pavement (Jointed) With Tied PCC Curb & Gutter
12 inches of Aggregate Subgrade, Type A

If you have any questions, please contact Paul Niedernhofer at
(217) 524-1651.

RECOMMENDATION

The proposed improvement consists of the reconstruction of approximately 29,333 square yards of pavement on IL 29 from Truitt Avenue to just south of Senachwine Creek in Chillicothe in Peoria County. According to the life cycle cost analysis, the present cost per mile per year for the rigid pavement is \$115,079, and the present cost per mile per year for the flexible pavement is \$133,460. This is a difference of about 16%. Therefore, it is recommended to use PORTLAND CEMENT CONCRETE PAVEMENT 9" (JOINTED) AND SUB-BASE GRANULAR MATERIAL, TYPE A (12").



PROJECT LOCATION
(IL 29 FROM TRUITT AVE.
TO SENACHWINE CREEK)

EXHIBIT A
LOCATION MAP

PAVEMENT DESIGN

FAP 318 (IL29)
SECTION : (6VB)BR;8R-1;(6,5)R
COUNTY : PEORIA
CATALOG NO : 034776-00D
CONTRACT NO : 68A92

ROUTE :	CLASS I	MIX TYPE :	PG64-22
NO. OF LANES :	5 LANES	MIX TEMPERATURE :	76 F
DESIGN PERIOD :	20 YEARS	TIED OR UNTIED SHOULDERS :	TIED
TRAFFIC GROWTH FACTOR :	1.25%	SUBGRADE SUPPORT RATING :	POOR
CONSTRUCTION YEAR :	2014	FACILITY TYPE :	OTHER MARKED STATE ROUTE

2011 TRAFFIC		
ADT =	10,500	
PV =	9,825	93.58%
SU =	350	3.33%
MU =	325	3.10%

2024 TRAFFIC		
ADT =	12,340	
PV =	11,547	
SU =	411	
MU =	382	

SUMMARY

The proposed work consists of approximately 29,333 square yards of pavement reconstruction on IL 29 in Chillicothe. The new pavement will consists of five lanes (see the typical section).

For this Pavement Design, only the Mechanistic Pavement Design Method was considered, as per Fig 54-1.A of the BDE Manual. According to the Mechanistic Pavement Design computations, (see exhibit C), the thickness of the jointed-rigid pavement shall be 9 inches, and the thickness of the flexible pavement shall be 10.25 inches.

MAINLINE		MECHANISTIC DESIGN				
Design Period	20			%PV	%SU	%MU
Growth RATE	1.25%			93.58%	3.33%	3.10%
Data Year/ADT	2011	10,500		9825	350	325
Construction Year	2014	10,899		PV	SU	MU
Design Year/ADT	2024	12,340		11,547	411	382

MINIMUM TRAFFIC FOR MECHANISTIC DESIGN				
FACILITY TYPE	PV	SU	MU	
INTERSTATE OR SUPL FREEWAY	\bar{Q}	500	1,500	
OTHER MARKED STATE ROUTE	\bar{Q}	250	750	
UNMARKED STATE ROUTE				750/1,500

RIGID			FLEXIBLE		
CPV	CSU	CMU	CPV	CSU	CMU
0.15	143.81	696.42	0.15	132.50	482.53
0.15	135.78	567.21	0.15	112.06	385.44
0.15	129.58	562.47	0.15	109.14	384.35
0.15	127.75	555.90	0.15	109.14	384.35
0.15	127.75	555.90	0.15	9.86	78.84
			CLASS I (4 LANES OR MORE) OR (ONE WAY WITH 3,501 OR MORE)		
			CLASS II (2 OR 3 LANES WITH ADT OVER 1,999) OR (ONE WAY UNDER 3,501)		
			CLASS III (2 OR 3 LANES WITH ADT 751 TO 1,999)		
			CLASS VI (2 OR 3 LANES WITH ADT 401 TO 750)		
			CLASS VI (2 OR 3 LANES WITH ADT UNDER 400)		

	RURAL				URBAN			NUMBER OF LANES
	P	S	M		P	S	M	
	1.00	1.00	1.00		1.00	1.00	1.00	1 LANE (RAMP)
	0.50	0.50	0.50		0.50	0.50	0.50	1, 2 OR 3 LANES
	0.32	0.45	0.45		0.32	0.45	0.45	4 OR 5 LANES
	0.20	0.40	0.40		0.08	0.37	0.37	6 OR MORE LANES

[illegible]

FLEXIBLE													
20	X	(CPV	P	PV	CSU	S	SU	CMU	M	MU	= 2.16	
			0.15	0.32	X 11,547	X 132.50	X 0.45	X 411	X 482.53	X 0.45	X 382		
1,000,000													
TF (actual) =													
20	X	(CPV	P	PV	CSU	S	SU	CMU	M	MU	= 3.56	
			0.15	0.32	X 0	X 132.50	X 0.45	X 250	X 482.53	X 0.45	X 750		
1,000,000													
TF (Min) =													

MECHANISTIC DESIGN: (JPCP)

A. Given:

- 4,000 Feet of New Pavement
- Sub grade Support Rating (SSR) = poor
- Edge-Tied Support

From Figure 54-2.B of Chapter 54 of the BDE manual, the following information is obtained:

Number of Facility Lanes	Percent of Total Vehicular Class Volume (ADT) in Design Lane					
	Rural			Urban		
	PV	SU	MU	PV	SU	MU
2 or 3*	50%	50%	50%	50%	50%	50%
4	32%	45%	45%	32%	45%	45%
≥ 6	20%	40%	40%	8%	37%	37%

* One-way roads and streets.

DESIGN LANE DISTRIBUTION FACTORS FOR STRUCTURAL DESIGN TRAFFIC

Figure 54-2.B

B. Solutions:

1. Traffic Factor

Class I	$TF = DP \left[\frac{(0.15 \cdot P \cdot PV) + (143.81 \cdot S \cdot SU) + (696.42 \cdot M \cdot MU)}{1 \times 10^6} \right]$	Equation 54-4.1
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- Using Equation 54-4.1 of the BDE manual for a Class I facility:

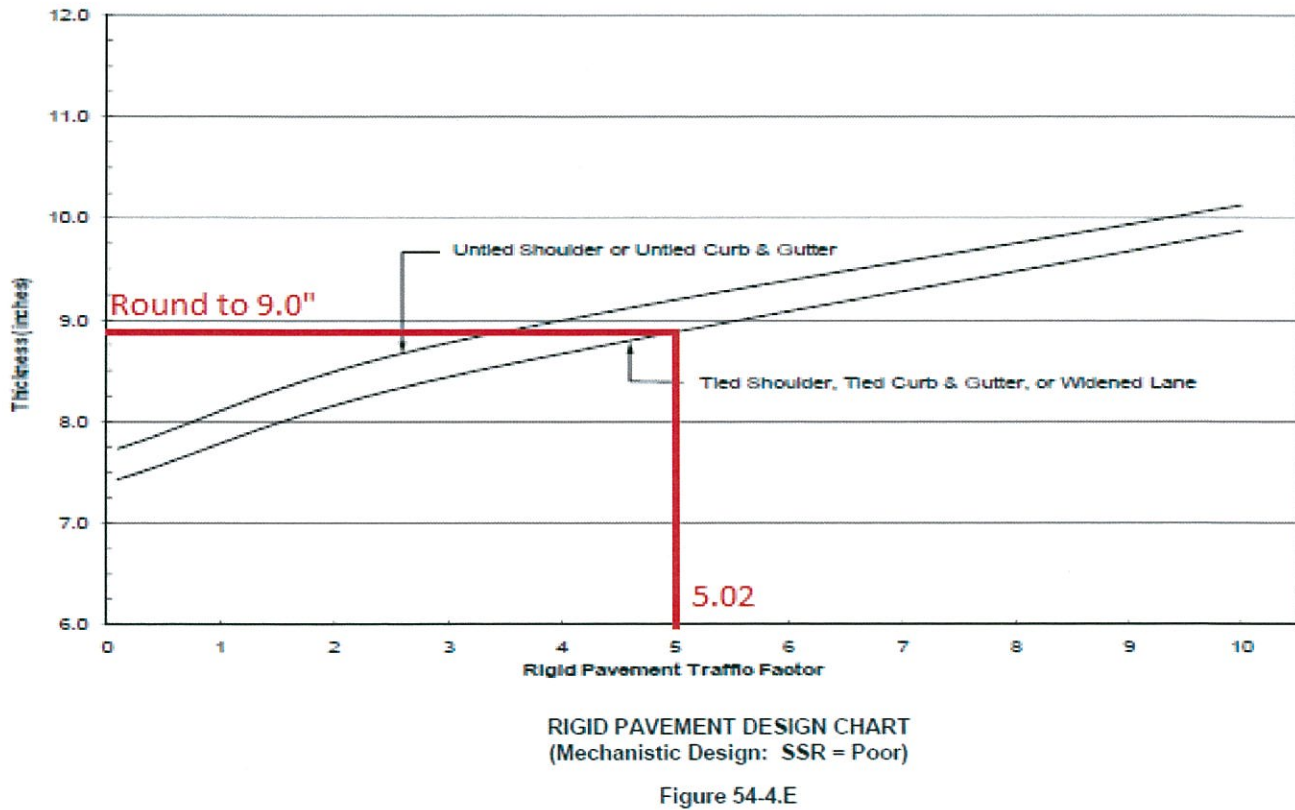
$$TF_{R(actual)} = 2.94$$

$$TF_{R(minimum)} = 5.02 \text{ (Controls)}$$

2. Thickness:

For Rigid Design:

- From Figure 54-4.E of the BDE manual:



- Using a poor SSR subgrade and a traffic factor of 5.02, the PCC pavement thickness is 9.00".

MECHANISTIC DESIGN: (Full Depth HMA)

A. Given:

- 4,000 Feet of New Pavement
- Sub grade Support Rating (SSR) = poor
- Asphalt Binder Type = PG 64-22

B. Solutions:

1. Traffic Factor

Facility Class	Traffic Factor Equation	Equation Number
Class I	$TF = DP \left[\frac{(0.15 \cdot P \cdot PV) + (132.50 \cdot S \cdot SU) + (482.53 \cdot M \cdot MU)}{1 \times 10^6} \right]$	Equation 54-5.1

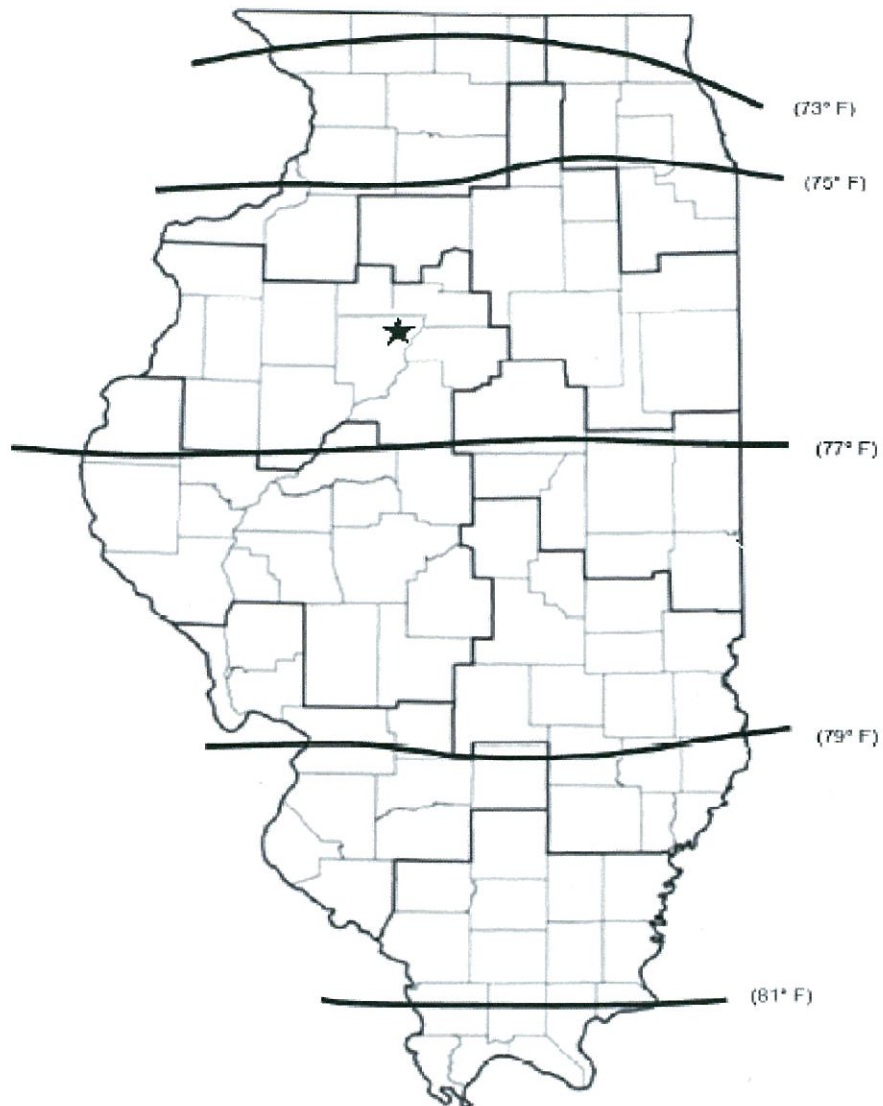
- Using Equation 54-5.1 of the BDE manual for a Class I facility:

$$TF_{R(\text{actual})} = 2.16$$

$$TF_{R(\text{minimum})} = 3.56 \text{ (Controls)}$$

2. AC Mix Temperature:

- From Figure 54-5.C of the BDE manual, use temperature = **76° F**



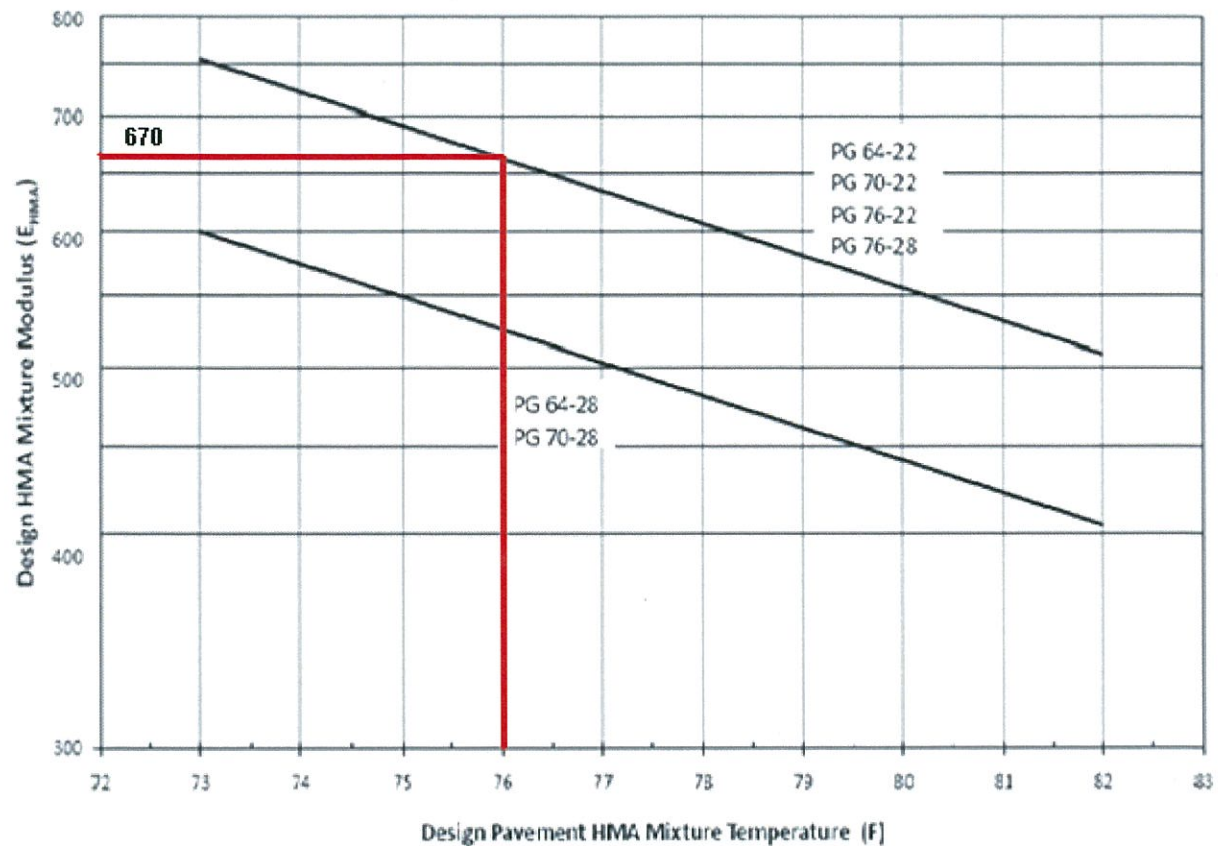
Note: The minimum design HMA mixture temperature will be 73°F.

HMA MIXTURE TEMPERATURE
(Mechanistic Design: Flexible Pavement)

Figure 54-5.C

3. Design E_{HMA} :

- From Figure 54-5.D of the BDE manual, $E_{HMA} = 670$ ksi

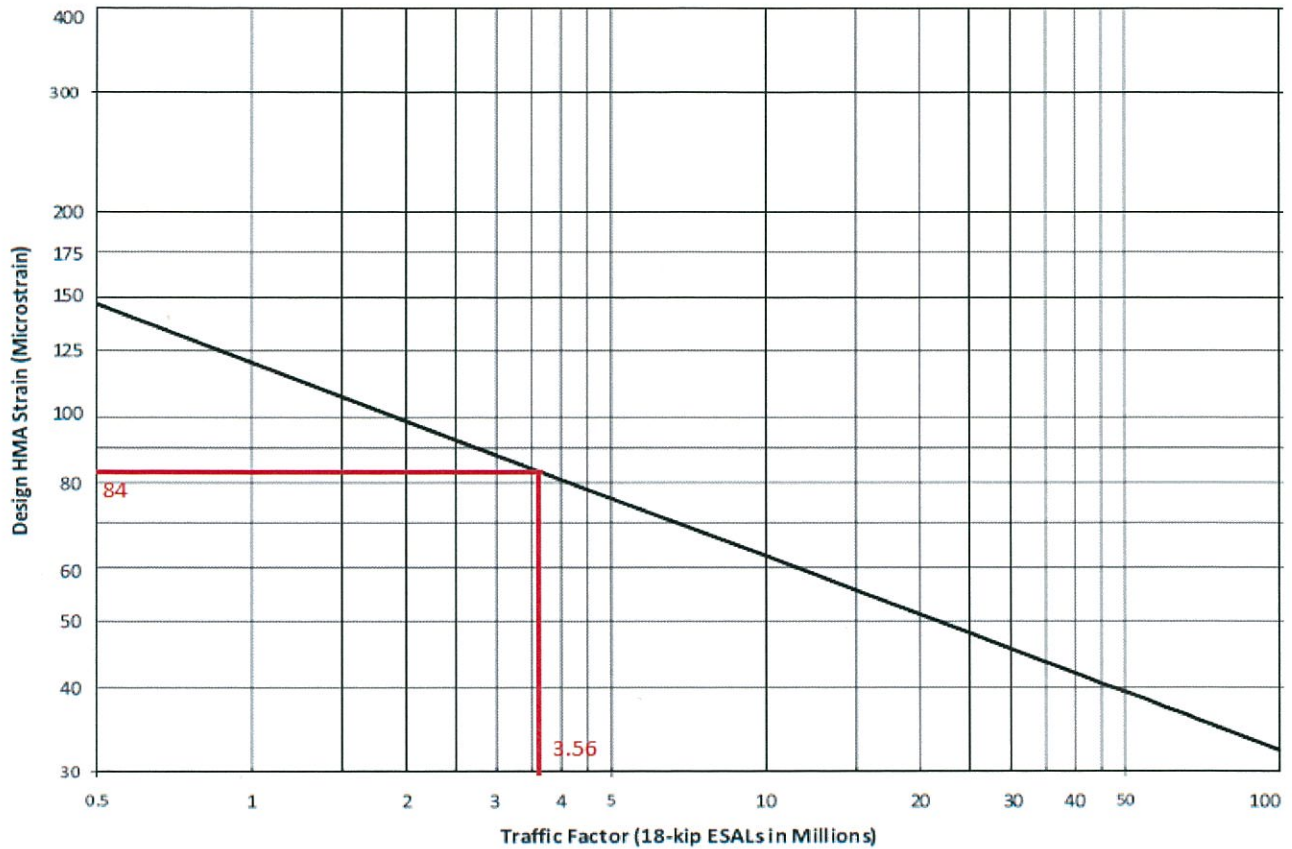


HMA MIXTURE MODULUS (E_{HMA})
(Mechanistic Design: Flexible Pavement)

Figure 54-5.D

4. Design HMA Strain:

- From Figure 54-5.E of the BDE manual, HMA Strain = **84**



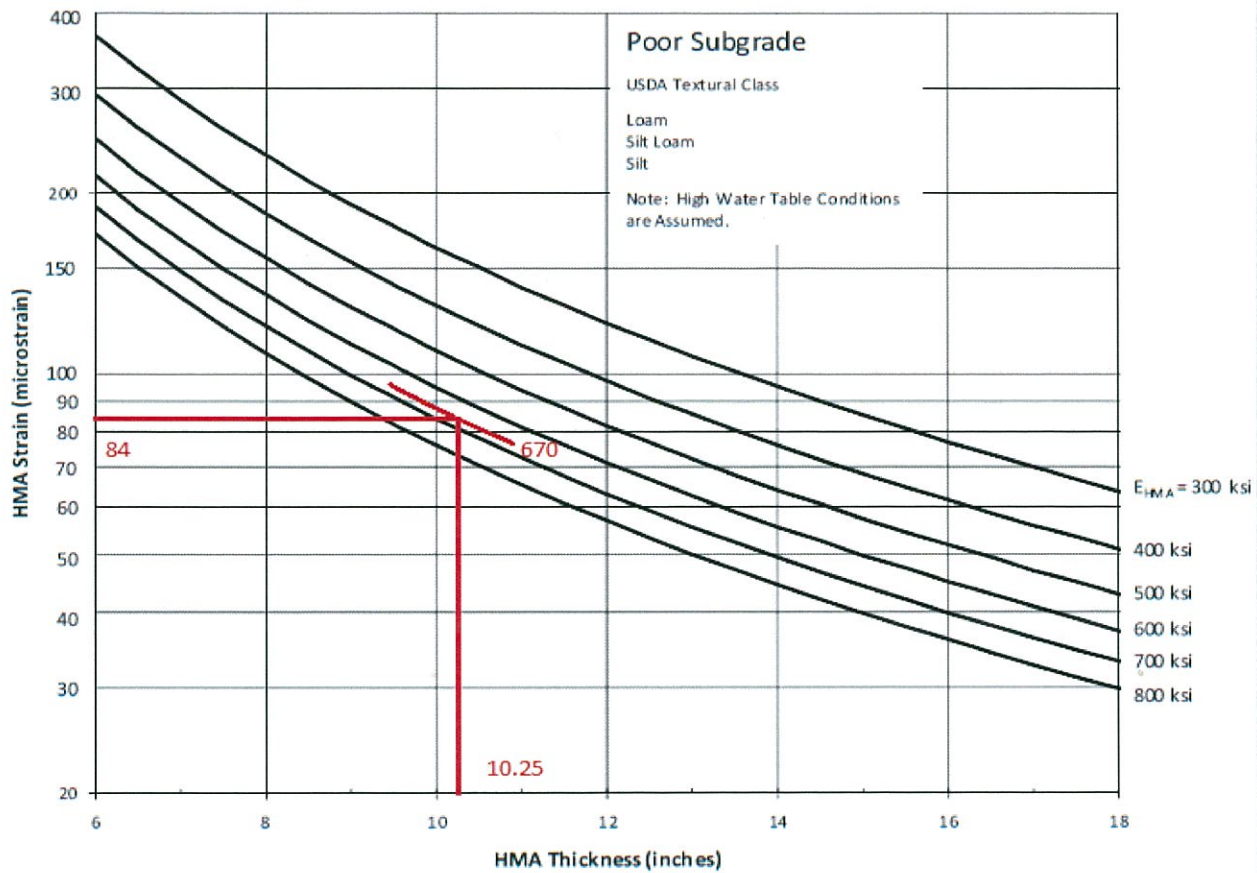
DESIGN HMA STRAIN
(Mechanistic Design: Flexible Pavement)

Figure 54-5.E

5. Thickness:

For Flexible Design:

- From Figure 54-5.F of the BDE manual, Thickness = **10.25 inches**



HMA THICKNESS DESIGN CHART
(Mechanistic Design: Flexible Pavement: SSR = Poor)

Figure 54-5.F

COST SUMMARY

RIGID PAVEMENT

RIGID PRESENT COST PER MILE PER YEAR: **\$115,079.00**

FLEXIBLE PAVEMENT

FLEXIBLE PRESENT COST PER MILE PER YEAR: **\$133,460.00**

PERCENT DIFFERENCE = 16%

RECOMMENDATION

The recommended pavement is PCC PAVEMENT 9" (JOINTED) due to the present cost per mile per year of flexible pavement being 16% greater than that of the rigid pavement.

PAVT	0.7576 miles		# OF	# OF	# OF	AREA (SQ YD)
	L (FT)	W (FT)	LANES	EDGES	C LINES	
	4,000	13	5	4	2	

SHLDR	L (FT)	LT W (FT)	RT W (IN)	# OF LT	# OF RT	AREA (SQ YD)
	0	0	0	0	0	

MAINTENANCE AND REHABILITATION ACTIVITY SCHEDULE							
JOINTED PLAIN CONCRETE PAVEMENT				RIGID			
AND UNBONDED JOINTED PAIN CONCRETE OVERLAY							
ITEM		QUANTITY	UNIT	UNIT PRICE	PRES CONST COST	PRES CONST COST/MILE	
9 "	PCC PAVEMENT 9" (JOINTED)	29,333	SQ YD	\$44.96	\$1,318,827		
12 "	SUB-BASE GRAN MATRL TYPE A (12")	20,044	TON	\$19.49	\$390,666		
PRESENT CONSTRUCTION COSTS OVER THE PERIOD OF 45 YEARS					\$1,709,493	\$2,256,531	
ACTIVITIES		QUANT	UNIT	UNIT PRICE	FUT REHAB COST	FUT REHAB COST/MILE	PRES REHAB COST/MILE
ACTIVITY 1 ---- YEAR 10		PWF10= 0.7441					
0.10%	CLASS B PAVEMENT PATCHING	29	SQ YD	\$175.00	\$5,133	\$6,776	\$5,042
ACTIVITY 2 ---- YEAR 15		PWF15= 0.6419					
0.20%	CLASS B PAVEMENT PATCHING	59	SQ YD	\$175.00	\$10,267	\$13,552	\$8,699
ACTIVITY 3 ---- YEAR 20		PWF20= 0.5537					
2.00%	CLASS B PAVEMENT PATCHING	587	SQ YD	\$175.00	\$102,667		
0.50%	CLASS C SHOULDERS PATCHING	0	SQ YD	\$100.00	\$0		
100%	LONGITUDINAL SHOULDER JOINT ROUTING AND SEALING	0	LIN FT	\$0.00	\$0		
100%	CENTER LINE JOINT ROUTING AND SEALING	8,000	LIN FT	\$2.00	\$16,000		
					\$118,667	\$156,640	\$86,732
ACTIVITY 4 ---- YEAR 25		PWF25= 0.4776					
3.00%	CLASS B PAVEMENT PATCHING	880	SQ YD	\$175.00	\$154,000		
1.00%	CLASS C SHOULDERS PATCHING	0	SQ YD	\$100.00	\$0		
					\$154,000	\$203,280	\$97,087
ACTIVITY 5 ---- YEAR 30		PWF30= 0.4120					
4.00%	CLASS B PAVEMENT PATCHING	1,173	SQ YD	\$175.00	\$205,333		
1.50%	CLASS C SHOULDERS PATCHING	0	SQ YD	\$100.00	\$0		
2.25 "	HMA OVERLAY OF PAVEMENT	3,696	TON	\$95.00	\$351,120		
1.50 "	HMA OVERLAY OF SHOULDERS	0	TON	\$75.00	\$0		
					\$556,453	\$734,518	\$302,622
ACTIVITY 6 ---- YEAR 35		PWF35= 0.3554					
100%	LONGITUDINAL SHOULDER JOINT ROUTING AND SEALING	0	LIN FT	\$0.00	\$0		
100%	CENTER LINE JOINT ROUTING AND SEALING	8,000	LIN FT	\$2.00	\$16,000		
50%	RANDOM CRACK ROUTE & SEAL	10,000	LIN FT	\$2.00	\$20,000		
40%	REFLEC TRANSVERSE CRACK ROUTE & SEAL	8,000	LIN FT	\$2.00	\$16,000		
0.10%	PARTIAL-DEPTH PAVEMENT PATCHING	29	SQ YD	\$75.00	\$2,200		
					\$54,200	\$71,544	\$25,427
ACTIVITY 7 ---- YEAR 40		PWF40= 0.3066					
0.50%	CLASS B PAVEMENT PATCHING	147	SQ YD	\$175.00	\$25,667		
100%	LONGITUDINAL SHOULDER JOINT ROUTING AND SEALING	16,000	LIN FT	\$0.00	\$0		
100%	CENTER LINE JOINT ROUTING AND SEALING	8,000	LIN FT	\$2.00	\$16,000		
60%	REFLEC TRANSVERSE CRACK ROUTE & SEAL	12,000	LIN FT	\$2.00	\$24,000		
50%	RANDOM CRACK ROUTE & SEAL	10,000	LIN FT	\$2.00	\$20,000		
0.50%	PARTIAL-DEPTH PAVEMENT PATCHING	147	SQ YD	\$75.00	\$11,000		
					\$96,667	\$127,600	\$39,122
PRESENT REHAB COST PER MILE FOR THE PERIOD OF 45 YEARS							\$564,730
TOTAL PRESENT COST PER MILE FOR THE PERIOD OF 45 YEARS							\$2,821,260
PRESENT COST PER MILE PER YEAR		CRF45= 0.04079					\$115,079

PAVT	0.7576 miles		# OF LANES 5	# OF EDGES 4	# OF C LINES 2	AREA (SQ YD) 29,333
	L (FT) 4,000	W (FT) 13				

SHLDR	LENGTH L(FT)	LT WIDTH (FT)	RT WIDTH (FT)	# OF LT	# OF RT	AREA (SQ YD)
	0	0	0	0	0	0

FULL-DEPTH HMA PAVEMENT				FLEXIBLE			
ITEM		QUANTITY	UNIT	UNIT PRICE	PRES CONST COST	PRES CONST COST/MILE	
2 "	Polymerized HMA Surface Course Mix "E" IL-9.5 or 12.5, N50	3,285	TON	\$97.85	\$321,470		
2.25 "	Polymerized H M A Binder Course IL-19.0, N50	3,696	TON	\$84.83	\$313,532		
6 "	H M A Binder Course IL-19.0, N50 6"	9,856	TON	\$78.54	\$774,090		
12 "	SUB-BASE GRAN MATRI TYPE A 12"	20,044	TON	\$19.49	\$390,666		
PRESENT CONSTRUCTION COSTS OVER THE PERIOD OF 45 YEARS					\$1,799,758	\$2,375,681	
ACTIVITIES		QUANT	UNIT	UNIT PRICE	FUT REHAB COST	FUT REHAB COST/MILE	PRES REHAB COST/MILE
ACTIVITY 1 ---- YEAR 5		PWF5=	0.8626				
100%	LONGITUDINAL SHOULDER JOINT ROUTING & SEALING	0	LIN FT	\$2.00	\$0		
100%	CL JOINT ROUTING & SEALING (SINGLE LANE PAVING)	8,000	LIN FT	\$2.00	\$16,000		
50%	RANDOM/THERMAL CRACK ROUTING & SEALING (SEE NOTE)	11,000	LIN FT	\$2.00	\$22,000		
0.10%	PARTIAL-DEPTH PAVEMENT PATCHING (MILL & FILL SURFACE)	29	SQ YD	\$75.00	\$2,200		
					\$40,200	\$53,064	\$45,773
ACTIVITY 2 ---- YEAR 10		PWF10=	0.7441				
100%	LONGITUDINAL SHOULDER JOINT ROUTING & SEALING	0	LIN FT	\$2.00	\$0		
100%	CENTERLINE JOINT ROUTING & SEALING	8,000	LIN FT	\$2.00	\$16,000		
50%	RANDOM/THERMAL CRACK ROUTING & SEALING (SEE NOTE)	11,000	LIN FT	\$2.00	\$22,000		
0.50%	PARTIAL-DEPTH PAVEMENT PATCHING (MILL & FILL SURFACE)	147	SQ YD	\$75.00	\$11,000		
					\$49,000	\$64,680	\$48,128
ACTIVITY 3 ---- YEAR 15		PWF15=	0.6419				
2 "	MILLING-PAVEMENT AND SHOULDERS	29,333	SQ YD	\$2.00	\$58,667		
1.0%	PARTIAL-DEPTH PAVEMENT PATCHING (MILL AND FILL ADDITIONAL 2 IN)	293	SQ YD	\$75.00	\$22,000		
2 "	HMA OVERLAY SURFACE POLYMER MIX "D"	3,285	TON	\$95.00	\$312,107		
2 "	HMA OVERLAY SHOULDERS	0	TON	\$75.00	\$0		
					\$392,773	\$518,461	\$332,800
ACTIVITY 4 ---- YEAR 20		PWF20=	0.5537				
100%	LONGITUDINAL SHOULDER JOINT ROUTING & SEALING	0	LIN FT	\$2.00	\$0		
100%	CENTERLINE JOINT ROUTING & SEALING	8,000	LIN FT	\$2.00	\$16,000		
50%	RANDOM/THERMAL CRACK ROUTING & SEALING (SEE NOTE)	11,000	LIN FT	\$2.00	\$22,000		
0.10%	PARTIAL-DEPTH PAVEMENT PATCHING (MILL & FILL SURFACE)	29	SQ YD	\$75.00	\$2,200		
					\$40,200	\$53,064	\$29,382
ACTIVITY 5 ---- YEAR 25		PWF25=	0.4776				
100%	LONGITUDINAL SHOULDER JOINT ROUTING & SEALING	0	LIN FT	\$2.00	\$0		
100%	CENTERLINE JOINT ROUTING & SEALING	8,000	LIN FT	\$2.00	\$16,000		
50%	RANDOM/THERMAL CRACK ROUTING & SEALING (SEE NOTE)	11,000	LIN FT	\$2.00	\$22,000		
0.50%	PARTIAL-DEPTH PAVEMENT PATCHING (MILL & FILL SURFACE)	147	SQ YD	\$75.00	\$11,000		
					\$49,000	\$64,680	\$30,891
ACTIVITY 6 ---- YEAR 30		PWF30=	0.4120				
2 "	MILLING PAVEMENT AND SHOULDERS	29,333	SQ YD	\$2.00	\$58,667		
2.0%	PARTIAL-DEPTH PAVEMENT PATCHING (MILL AND FILL)	587	SQ YD	\$75.00	\$44,000		
1.0%	PARTIAL-DEPTH SHOULDERS PATCHING (MILL AND FILL)	0	SQ YD	\$75.00	\$0		
3.75 "	HMA OVERLAY-PAVT POLYMER MIX "D"	6,160	TON	\$95.00	\$585,200		
1.75 "	HMA OVERLAY-SHOULDERS	0	TON	\$75.00	\$0		
					\$687,867	\$907,984	\$374,089
ACTIVITY 7 ---- YEAR 35		PWF35=	0.3554				
100%	LONGITUDINAL SHOULDER JOINT ROUTING & SEALING	0	LIN FT	\$2.00	\$0		
100%	CENTERLINE JOINT ROUTING & SEALING	8,000	LIN FT	\$2.00	\$16,000		
50%	RANDOM/THERMAL CRACK ROUTING & SEALING (SEE NOTE)	11,000	LIN FT	\$2.00	\$22,000		
0.10%	PARTIAL-DEPTH PAVEMENT PATCHING (MILL & FILL SURFACE)	29	SQ YD	\$75.00	\$2,200		
					\$40,200	\$53,064	\$18,859
ACTIVITY 8 ---- YEAR 40		PWF40=	0.3066				
100%	LONGITUDINAL SHOULDER JOINT ROUTING & SEALING	0	LIN FT	\$2.00	\$0		
100%	CENTERLINE JOINT ROUTING & SEALING	8,000	LIN FT	\$2.00	\$16,000		
50%	RANDOM/THERMAL CRACK ROUTING & SEALING (SEE NOTE)	11,000	LIN FT	\$2.00	\$22,000		
0.50%	PARTIAL-DEPTH PAVEMENT PATCHING (MILL & FILL SURFACE)	147	SQ YD	\$75.00	\$11,000		
					\$49,000	\$64,680	\$19,831
PRESENT REHAB COST PER MILE FOR THE PERIOD OF 45 YEARS							\$899,753
TOTAL PRESENT COST PER MILE FOR THE PERIOD OF 45 YEARS							\$3,275,434
PRESENT COST PER MILE PER YEAR		CRF45=	0.04079				\$133,605